

What is claimed is:

1. A solder joint life prediction method for predicting the joint life of joining solder which joins members with each other, comprising:

a crack initiation prediction step of running a fatigue test on soldered joints, observing phase growth in a crack pre-initiation stage of the joining solder, extrapolating the phase growth, and thereby predicting the time of crack initiation when an initial crack will appear in the joining solder; and

a fracture time calculation step of performing creep analysis by a finite element method with a virtual initial crack given to data-based joining solder, and thereby predicting the time of fracture when the virtual crack grows long enough to be a fracture.

2. The solder joint life prediction method according to claim 1, wherein the fracture time calculation step involves calculating equivalent non-linear strain amplitude  $\Delta\epsilon$  by elasto-plastic creep analysis based on the finite element method with the virtual initial crack given to the data-based joining solder, converting the equivalent non-linear strain amplitude  $\Delta\epsilon$  into a crack growth rate by the application of the Coffin-Manson law, and calculating the time of fracture based on the crack growth rate.

3. The solder joint life prediction method according to claim 1, wherein the fracture time calculation step involves calculating

an integration interval  $\Delta J_c$  of creep  $J$  by elastic creep analysis based on the finite element method with the virtual initial crack given to the data-based joining solder, converting the integration interval  $\Delta J_c$  of the creep  $J$  into a crack growth rate, and calculating the time of fracture based on the crack growth rate.

4. The solder joint life prediction method according to claim 1, comprising:

an actual measurement step of actually measuring phase growth beforehand at the time when initial cracks appear by running a fatigue test on soldered joints until the initial cracks appear in joining solder,

wherein the crack initiation prediction step involves running a fatigue test on soldered joints, observing phase growth in a crack pre-initiation stage of the joining solder, extrapolating the phase growth, and predicting the time when the phase growth reaches a level equivalent to the value of the phase growth actually measured at the time when the initial cracks appear in the actual measurement step, as the time of crack initiation.

5. The solder joint life prediction method according to claim 4, wherein:

the actual measurement step involves actually measuring the phase growth at the time when the initial cracks appear in the joining solder, continuing the fatigue test even after the initial

cracks appear until cracks equivalent to a fracture are formed in the soldered joints, and thereby measuring the time of fracture counting from the time of crack initiation;

the solder joint life prediction method comprises a virtual initial crack calculation step of determining the length of the virtual initial crack to be given to the data-based joining solder such that the time of fracture obtained by the same calculation as the one used in the fracture time calculation step will correspond to the actually measured time of fracture in the actual measurement step; and

the fracture time calculation step involves giving the virtual initial crack of the length determined in the virtual initial crack calculation step to the data-based joining solder and performing creep analysis by the finite element method.

6. The solder joint life prediction method according to claim 1, wherein the crack initiation prediction step involves predicting the time of crack initiation by giving a heat cycle test to the soldered joints as the fatigue test.

7. The solder joint life prediction method according to claim 1, wherein the crack initiation prediction step involves predicting the time of crack initiation by giving a mechanical cycle test to the soldered joints as the fatigue test.

8. The solder joint life prediction method according to claim 1, wherein the crack initiation prediction step involves predicting the time of crack initiation by giving a load test at elevated temperature to the soldered joints as the fatigue test.